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A New Blood Parasite of British Cats

BY

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SUMMARY.—A blood parasite, provisionally designated Eperythrozoon felis, *was detected in blood smears taken from 6 cats presented at a Cambridge small-animal clinic. Morphologically the organism resembled a similar parasite, designated* Haemobartonella felis, *which is responsible for feline infectious anaemia in the United States.* E. felis *occurred on the surface of the erythrocytes, up to 50 per cent. of which were parasitised in experimental infections. Although anaemia occurred in experimentally infected cats, no other disease directly attributable to the infection was observed.*

Introduction

IN 1942, Clark, working in South Africa, described the occurrence of annular eperythrocytic organisms in blood and spleen smears which had been taken from an anaemic cat and sent to him for examination. Although Clark described the organisms from *post-mortem* material only, he considered that they represented a new species, for which he proposed the name *Eperythrozoon felis*. Eleven years later, in America, Flint and Moss (1953) described an infectious anaemia of cats, which they attributed to blood parasites of the genus *Haemobartonella* or *Eperythrozoon*. Flint and McKelvie (1955) proposed the name *Haemobartonella felis* for the organisms.

Since the publication of Flint and Moss (1953) there have been other American reports of an infectious anaemia of cats associated with erythrocytic parasites. Each of these reports appears to be dealing with the same condition as that described by Flint and Moss (1953), but the name *Haemobartonella felis* is not used in them (Holzworth, 1956 ; Splitter *et al.*, 1956; Schwartzman & Besch, 1958).

Since feline infectious anaemia appears to be fairly widespread in the United States (Flint *et al.*, 1958), it was decided to see whether the causal agent occurred in Britain. In a preliminary survey, blood smears were obtained from 8 cats presented at the small-animal clinic of the School of Veterinary Medicine, Cambridge, in December, 1957, and January and February, 1958. In a blood smear obtained from one of these cats, organisms morphologically similar to those described in the earlier reports were detected.

With the detection of eperythrocytic parasites in the blood of a British cat a problem of nomenclature arose. The generic differences between *Haemobartonella* and *Eperythrozoon* are not well defined. Since the organism concerned resembles that originally described by Clark (1942), it has been provisionally designated *Eperythrozoon felis*, until such time as the taxonomy and nomenclature of the parasites occurring in South Africa, America and Great Britain can be clarified further.

Materials and Methods

In order to determine the natural incidence of *Eperythrozoon felis* a survey was conducted. All cats presented at the small-animal clinic on either of 2 days in each week were included in the survey and a blood smear was taken from each cat on its first visit. The survey began early in March and continued until the end of July, 1958. Details of the age, sex, general condition, presence or absence of ecto-parasites, and condition of the visible mucous membranes of each cat were recorded for the purposes of the survey. More detailed clinical records were also available.

The size and morphology of eperythrozoa has led to their confusion with artifacts in stained blood smears. Every effort was made, therefore, to avoid errors due to this source both in preparation of smears and in their interpretation. New, clean, grease-free microscope slides were used. They were

stored in absolute alcohol until required. Before use, the alcohol on each slide was ignited and burned dry, and the slide was polished with a soft cloth.

Blood smears were obtained from the inner surfaces of the cats' ears. The ear was cleansed with a dry swab and the selected area pricked with a surgical needle. The needles were sterilised by heat after use on each cat. On arrival at the laboratory, the blood smears were fixed in methyl alcohol for 3 minutes and stained by Giemsa's method for 90 minutes. The Giemsa stain was diluted 1 in 16 with phosphate buffer *p*H 7.2, and the slides were stained in an inverted position on a curved glass staining tray. After examination, the smears from the cats included in the survey were recorded as positive, negative, or doubtful. In the latter case a further blood smear was to be obtained if possible.

Six young cats were used in transmission experiments. Each cat was vaccinated with feline infectious enteritis vaccine* before use, and benzene hexachloride was used prophylactically throughout the experiments to control infestations with otodectic mites and other ectoparasites. Blood smears were obtained from each cat on 3 days of each week. Smears were taken from the cats for periods of 19 to 29 days prior to the experiments in order to detect the existence of natural infection. Four cats were inoculated intraperitoneally with 0.5 to 1 ml. of heparinised blood taken from infected cats. Body temperatures were recorded daily during the earlier stages of 3 primary infections. One cat was splenectomised 65 days after inoculation.

Results

The Natural Incidence of Eperythrozoon felis

As already mentioned, *E. felis* was detected in a blood smear taken from one of the 8 cats examined during the preliminary survey.

Blood smears from 97 cats were examined during the main survey. *E. felis* was detected in the smears taken from 5 of these cats. In addition, smears from 3 cats were recorded as "doubtful," but no further blood smears were obtained from these 3 animals.

In all, smears from 105 cats were examined. Thirty-four of these cats were intact males, 52 were neutered males, 14 were intact females and 5 were neutered females. Their ages ranged from 2 months to 13 years.

Four of the cats which gave positive blood smears were intact males, 1 was a neutered male and 1 was a neutered female. Five of these cats were 1 to 2 years old, the sixth cat was 6 years old. The 3 cats from which "doubtful" smears were obtained were all neutered males and were aged 2, 7 and 8 years.

The age and sex distributions of the cats examined are given in Tables I and II.

Apart from one infected cat which had lymphadenitis, none of the infected or "doubtful" cases appeared to have been presented for reasons connected with infection of *E. felis*. Five of the 6 infected cats and 1 of the "doubtful" cases showed evidence of infestation with ectoparasites. Similar evidence was also found in about half of the cats examined in the survey.

*Burroughs Wellcome & Co.

The Morphology and Appearance of Eperythrozoon felis *in blood smears*

With Giemsa's stain, *E. felis* stained a purple colour similar to that of the nuclei of the leucocytes. The organisms always stained delicately and since their position upon infected erythrocytes varied, it was sometimes necessary to vary the depth of focus slightly before seeing them.

Almost all the eperythrozoa occurred on the erythrocytes. During the height of infection a few unattached organisms were detected. These were almost always annular in appearance and were most numerous at the tails of the blood smears.

The organisms occurred principally in coccoid or annular form of less than one micron in diameter. The annular forms were frequently ovoid or elongated rather than circular. Forms having centres less deeply stained than their periphery were not frequent. The outline of the coccoid forms was not always sharp. Beaded bacillary forms were seen, but a common formation was the combination of 2 or 3 coccoid forms in a short chain, which gave a similar appearance. Short rods and other forms were occasionally seen on the surface of the erythrocytes. The characteristic appearance of short rods at the periphery of an erythrocyte, ringing it in part, was fairly frequently seen. It is probable that these were not in fact true

TABLE I

THE AGE DISTRIBUTION OF 105 CATS EXAMINED FOR THE PRESENCE OF INFECTION WITH *E. felis*.

Age of cat in years	Number of cats examined	Number of cats found to be infected
0–	20	
0·9–	20	4
1·9–	11*	1
2·9–	7	
3·9–	7	
4·9–	5	
5·9–	4	1
6·9–	8*	
7·9–	5*	
8·9–	5	
9·9–	3	
10·9–	4	
11·9–	2	
12·9–13·9	1	
Not recorded	3	
Total :	105	6

* "Doubtful" smear obtained from 1 cat in each group.

TABLE II

THE SEX DISTRIBUTION OF 105 CATS EXAMINED FOR EVIDENCE OF INFECTION WITH *E. felis*.

	Intact males	Neutered males	Intact females	Neutered females	Total
Number examined	34	52*	14	5	105
Number infected	4	1	–	1	6

* "Doubtful" smears were obtained from 3 neutered male cats.

rods, but were coccoid or annular forms seen in profile.

Experimental Infections with Eperythrozoon felis

None of the 6 experimental cats showed evidence of *E. felis* in the blood smears taken from them prior to inoculation. Two cats were subsequently used as uninoculated controls, and no organisms were detected in the smears taken from these animals during a further observation period of one month.

Four experimental transmissions of *E. felis* were made; 2 of these were serial transmissions. On 2 occasions, separated by an interval of 62 days, 1 ml. of heparinised blood taken from a domestic pet (detected as a carrier of *E. felis* in the preliminary survey) infected 2 experimental cats. Heparinised blood taken from 1 of these cats infected 2 other experimental cats. In each case the inoculum was given by intraperitoneal injection.

One of the 4 prepatent periods observed was of 10 days duration, the other 3 were 12 days.

Patent infections were completely observed in 3 cats and lasted for 12, 18 and 22 days respectively. In each case recrudescences of parasitaemia occurred after short intervals. In the fourth cat patent infection was followed for 49 days in blood smears taken thrice-weekly, after which time no further examinations were made.

One cat was splenectomised 65 days after inoculation. A recrudescence of infection, which resembled the primary patent infection, followed the operation.

The numbers of eperythrozoa present in blood smears varied with the stage of infection. Initially only a few infected erythrocytes were seen, each carrying one or more organisms. The proportion of infected erythrocytes increased as the infection progressed until about 50 to 60 per cent. of them carried organisms. Erythrocytes infected with more than 5 organisms were relatively rare. Gradually the numbers of organisms and of infected erythrocytes decreased until only a few were seen in smears. This stage persisted for some time, although occasionally smears were obtained in which eperythrozoa could not be detected. Most of the infected cats detected in the survey appeared to be in this stage of infection.

The organisms exhibited no predilection for polychromatic erythrocytes. During the later stages of experimental infections, purple staining granules were seen in the cytoplasm of neutrophils and monocytes, and erythrophagocytosis by monocytes was also observed.

Figure 1 is a photograph of a blood smear taken from a cat experimentally infected with *E. felis*. In addition to the eperythrozoa, a degree of anisocytosis is exhibited.

No change of body temperature which could be related to the infection of *E. felis* was seen in any cat. All 4 infected cats developed an anaemia after the peak of the infection had passed. A similar anaemia also followed the peak of the secondary infection which occurred in the splenectomised cat. Polychromasia, normoblastosis and anisocytosis were evident in blood smears taken at this time, and the visible mucous membranes, especially the conjunctivae, were pallid. No other clinical signs of anaemia were detected.

In 2 cats an intercurrent infection occurred after the anaemic signs had regressed. In each case there was an initial high fever, with temperatures up to 106° F. accompanied by catarrh of the upper respiratory tract. In 1 cat a less severe febrile reaction persisted and an ulcerative condition of the mouth and anus developed. The cat became very emaciated and was destroyed. In the second cat the catarrhal syndrome was accompanied by lymphadenitis. This cat recovered and was later splenectomised. The course of these intercurrent infections was not related to the occurrence of large numbers of parasites in the peripheral blood.

Three cats, including the 1 which was splenectomised, grew into healthy adults and remained clinically normal for a period of 2 months after the experiments ceased.

At splenectomy the spleen of 1 cat was found to be enlarged. (It weighed 21.5 gm., whilst the cat weighed 1.7 kg. at this time). At the *post-mortem* examination of the cat which died, splenomegaly and a generalised lymphadenitis were observed. In addition to the ulcers noted in life, ulceration of the ileo-caeco-colic region was found and also a partly healed abscess in the left lung. Annular structures were detected in impression smears made from the spleen and lymph glands of this cat and stained with Giemsa, but these were not seen in sections, or in smears made from the spleen of the cat which was splenectomised.

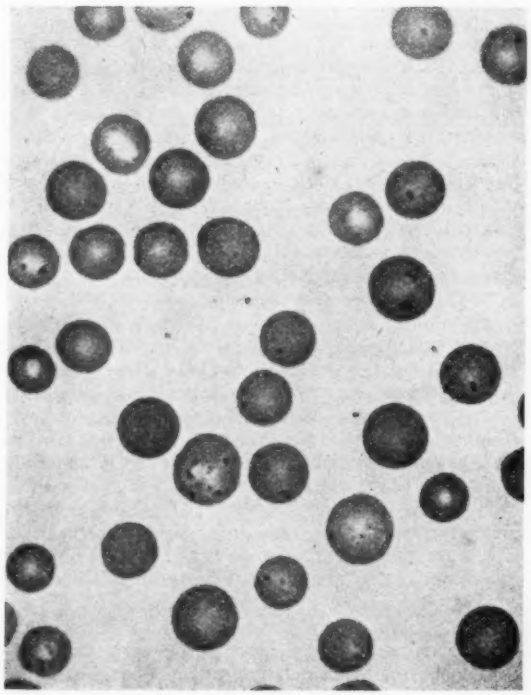

FIG. 1. Infection of *Eperythrozoon felis* in the blood of a cat, with anisocytosis. ×3600.

Discussion

Flint *et al.* (1958) recorded that feline infectious anaemia had been diagnosed in 8 States in the United States. These workers saw 30 clinical cases in about 3 years at one clinic in Utah. Twenty-eight cases occurred in male cats and 22 cases were in cats aged between 1 and 3 years. Flint *et al.* remarked that development or relapse of the disease was apparently favoured by sexual maturity. Holzworth (1956) described 28 cases. Fourteen of the cats were intact males, 7 were neutered males, 5 were intact females and 2 were neutered females. Fourteen cases occurred in cats 2 years old or younger. The age and sex incidence of infected cats in the present survey closely resembled that found in the United States. However, as Holzworth (1956) remarked with her cases, the distribution of infected cases also resembled the age and sex distribution of all cats presented at the clinic. The incidence of parasitaemia detected, 5.7 per cent., suggests that the infection is not uncommon in the Cambridge area. Since *E. felis* may not have been detected in blood smears taken from all the cats actually infected, it is possible that the real incidence is higher than that recorded.

The erythrocytic parasites described by Flint and Moss (1953), who used Wright's stain, were very pleomorphic. Later Flint *et al.* (1958), using Giemsa's stain, described bacillary and coccoid forms, the latter frequently in short chains, as the principal forms. Annular forms and organisms not attached to erythrocytes were rare. Clark (1942) had earlier described *Eperythrozoon felis* as principally of annular and coccoid morphology. Although Splitter *et al.* (1956) considered the organisms with which they were working to be similar to that of Flint and his collaborators, annular and coccoid forms were reported to predominate. Schwartzman and Besch (1958) refer to "eperythrozoon-like bodies" throughout their paper. The organisms seen in the present study were principally coccoid and annular. The slight discrepancies which occur in the various morphological descriptions may be due to technical differences in the preparation of smears rather than to actual differences in morphology.

The causal agent of feline infectious anaemia was transmitted from infected cats to susceptible cats by intraperitoneal injections of blood (Flint & Moss, 1953; Splitter *et al.*, 1956). Both groups of workers produced parasitaemia and disease in intact cats. Splenectomy, either before or after infection, did not appear to have a significant effect. Characteristically, infections of *Haemobartonella* or *Eperythrozoon* are very mild, or even inapparent, in intact animals, but there are exceptions to this rule. Splenectomy usually activates latent infections, and it is usually necessary to conduct experiments in splenectomised animals.

Wide variations have been recorded in the prepatent periods of the infection (Flint & Moss, 1953; Splitter *et al.*, 1956; Schwartzman & Besch, 1958). All authors are agreed that some experimental cats develop a severe and often fatal anaemia. This frequently became manifest shortly before death. Cachexia, anorexia and extreme weakness were exhibited. In clinical practice, 15 of 30 cases presented to Flint *et al.* (1958) were moribund, and other cases were presented with complications such as abscesses.

In the present study *E. felis* was transmitted to 4 cats by the intraperitoneal injection of infected blood. Prepatent periods of 10 and 12 days were observed, and were followed by patent infections of 2 weeks or longer duration. Splenectomy of 1 of the cats appeared to produce a recrudescence of infection. All the cats developed anaemia which might have gone undetected had not the appearance of blood smears been noted and the conjunctivae examined. No clinical cases of feline infectious anaemia were seen, either in cats presented during the survey, or in the experimental cats. Two experimental cats developed intercurrent infections, from which one died. Although there was no evidence to relate the infection of *E. felis* to the intercurrent infections, it is possible that the presence of the parasites had sufficiently lowered the resistance of their hosts to render them more susceptible to disease. Since the American workers report that infected cats may be presented in a moribund condition, or with complicating secondary infections, it is possible that cases of feline infectious anaemia have occurred in this country, but have not so far been recognised.

Acknowledgements.—We wish to acknowledge the assistance of Mr. R. G. Walker and the staff of the Veterinary Hospital with the splenectomy of a cat, and of Mr. M. A. E. Rex in obtaining some of the blood smears during the survey. This work was carried out during the tenure by one of us (J.S.) of a Crookes Research Fellowship.

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DIRECTOR-GENERAL OF FAO VISITS THE UNITED KINGDOM

Mr. B. R. Sen, Director-General of FAO since 1956, is visiting this country at the invitation of the Minister of Agriculture, Fisheries and Food from May 9th to 19th.

The purpose of Mr. Sen's visit is to meet representatives of H.M. Government concerned with FAO and with food and agriculture generally, and to see something of what is being done in this country in those fields. Dr. Norman Wright, until recently Chief Scientific Adviser (Food) to the Ministry of Agriculture, Fisheries and Food, is now Deputy Director of FAO.

The Effect of Surgical Intervention in a Case of Chronic Pulmonary Osteoarthropathy in a Dog

BY

M. A. E. REX

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University of Cambridge

Introduction

CHRONIC pulmonary osteoarthropathy (Marie's Disease) was first described in man by Hippocrates (1923) in the 5th century B.C. It may be described as a progressive and usually symmetrical thickening of the limbs caused by periosteal proliferation, particularly affecting the more distal parts. In man cases have been reported associated with empyema, arteriovenous aneurysm of the lung, fibroma of the visceral pleura, bronchial carcinoma, benign tumours of lung and chest wall, some congenital heart conditions, and some extra-thoracic conditions (Semple, 1955). In dogs the disease is associated with chronic conditions of the lung which are usually neoplastic or tuberculous, although White (1942) reported a case associated with adenocarcinoma of the liver in which no secondary tumours were found in the lungs. The clinical, *post-mortem* and histological findings have been described fully in the veterinary literature (for example, by Smythe, 1929; Wooldridge & Holmes, 1937; Craig & Davies, 1940; Poley & Taylor, 1942; White, 1942; Cotchin, 1944; Rumney & Schofield, 1950; Cordy & Dinsmore, 1950; Schlotthauer & Millar, 1951; Mather & Low, 1953; Lord, 1959). Lumb and Carlson (1956) and Brodey and Wind (1957) have reported regression of the signs of osteoarthropathy after surgical interference in the dog. The case reported below gives further evidence of the effects of surgery in these cases.

Case History

A 3-year-old male Boxer was presented at this hospital with a history of loss of flesh and thickening of the legs over the previous 2 months. A swelling on the left side of the chest had been noticed for about 2 weeks. Appetite and thirst were normal.

The dog was in an emaciated condition with thickening of all limbs from phalanges to humerus in the forelegs and phalanges to femur in the hind legs, causing a stiff gait and restriction of movement. The legs were hot and painful to touch, the skin was thickened and pitting occurred on pressure. Temperature was 101.5°F., pulse 120, and respiratory rate 24. There was a degree of exophthalmos, and a bilateral mucopurulent ocular discharge. There was a large hemi-spherical mass over the posterior half of the left chest wall, but no obvious respiratory distress (Plate I). Red and white blood cell counts showed a leucocytosis and were similar to those recorded by Rumney *et al.* (1950) and Cordy *et al.* (1950). Radiological examination of the legs showed the new bone structure to be similar to that reported by Holmes and Price (1958) (Plate II). The inner boundary of the thoracic mass could not be determined accurately by radiological examination, although it could be seen to occupy considerable space in the left chest and the heart was displaced to the right. In view of the success of surgical treatment in man (Milstein, 1958; Semple, 1955) and in dogs (Brodey & Wind, 1957), it was decided to attempt removal of the mass.

Anaesthetic

Premedication of pethidine hydrochoride 100 mg. levallorphan tartrate 1.25 mg. ("Pethilorfan" Roche) and atropine sulphate gr. 1/100 was given by the intramuscular route 1 hour before induction.

Induction was by intravenous thiopentone sodium 0.55 g., the dog was intubated with a No. V. 11 Magill cuffed endotracheal tube, and maintenance was by an oxygen nitrous oxide mixture using a semi-closed circuit on the circle absorber of a standard Boyle's apparatus. A total of 20 mg. suxamethonium chloride was given intravenously in intermittent doses during the operation to produce apnoea and enable respiration to be controlled. 540 ml. of whole blood and 800 ml. of plasma were given by intravenous drip during the operation, which lasted $2\frac{3}{4}$ hours.

Operation

Thoracotomy was performed through the 4th left intercostal space and a well encapsulated tumorous mass, involving the 5th, 6th, 7th and 8th ribs, was identified and removed together with the affected ribs. Two superficial adhesions were found between the tumour and the left cardiac and diaphragmatic lobes of the lung, one of which contained vessels of about 2 mm. diameter. The defect in the chest wall was made good by suturing a piece of stainless steel wire gauze about 15 cm. square to the surrounding muscles and suturing superficial muscle layers over this as far as possible. A rubber drainage tube connected to an underwater seal was inserted through a stab incision in the 9th intercostal space to the thoracic cavity before closing skin.

The tumour mass weighed $4\frac{1}{2}$ lb. and representative sections showed it to be a very malignant osteosarcoma.

Post-operative Progress

The immediate post-operative period was thought to be critical and constant watch was kept on the dog for the first 24 hours. "Pethilorfan" given intramuscularly was used to provide analgesia and maintain sedation. It was expected that there would be a considerable pleural effusion following the stripping of a large area of pleura, but this did not occur, only a very small volume of blood passing down the drainage tube. The tube was removed 20 hours after operation and the stab incision sealed. A good

intrapleural negative pressure had been maintained and the respiratory rate had fallen from 32 immediately post-operative to 20 by the time the tube was removed. Paracentesis thoracis was carried out several times during the next 3 weeks, but no fluid was obtained. Urine was collected for the first 24 hours by means of an indwelling polythene catheter. The dog ate 250 g. of meat 32 hours after the end of the operation.

The exophthalmos had regressed 3 days after the operation and there was no ocular discharge. Two weeks later the dog was very fit, running and jumping about, and showing no sign of heat or pain in the legs.

Starting 3 days after operation, measurements of the right foreleg and left hind leg were taken daily and 5 weeks later there was a decrease in circumference of 12 mm. in the former and 25 mm. in the latter. The main change seen on radiological examination of the legs was a limitation of new bone growth and a flattening of the boundary of the osteophytic outgrowths, with apparent sealing off of the new bone (Plate III and IV).

Subsequent Progress

The dog maintained this remarkable improvement for a period of 8 weeks, after which its physical condition started to deteriorate extremely rapidly and within a matter of days it became dull, apathetic and disinclined to move. The legs became thick, hot and painful again, and were in fact worse than when he was first examined. Radiological examination showed that the osteophytic outgrowths were reforming. At this time a swelling about 25 mm. diameter was noticed anterior to the left scapula ; this was removed and examined histologically. It proved to be an osteosarcoma. A bronchoscopy was performed at the same time, but nothing abnormal was detected. The dog was given cortisone by injection in 4 doses of 25 mg. and this relieved the pain in the legs. This effect has also been reported in man (Semple, 1955). In view of the dog's increasing discomfort, euthanasia was carried out 10 weeks after operation.

Post-mortem *Examination*

Neoplastic nodules varying in size from 1 to 12 mm. were present in all lobes of the right lung. Two larger nodules were found in the left cardiac lobe, there was a large neoplastic mass 35 mm. in diameter adherent to the chest wall in the left apical lobe, and there were several smaller ones throughout its substance. The left diaphragmatic lobe was considerably reduced in size and contained neoplastic nodules. The bronchial lymph nodes were enlarged but showed no evidence of neoplastic tissue. There was an atheromatous plaque in the pulmonary artery just above the cusps of the mitral valve. All cusps of the aortic valve were grossly thickened and distorted. The gauze filling the gap in the chest wall was completely covered with pleura. Histological examination of the nodules from the lungs showed that they were osteosarcomata.

Discussion

It is remarkable that such a large area of pleura was removed without provoking a massive pleural effusion. The blood vessels in the adhesion between tumour and lungs at operation may have been highly significant and presence of such vessels would seem to worsen the prognosis considerably. It is reasonable to conclude that the secondary tumour anterior to the scapula was due to local spread and that the secondaries found in the lungs were due to a combination of local spread and blood-borne "seeding." This dog was in an advanced stage of the disease when first examined and the fact that removal of the primary tumour enabled the dog to undergo such marked improvement for 2 months suggests that surgical intervention may be of use if early diagnosis is made. Lumb and Carlson (1956) also obtained clinical improvement in a mongrel dog suffering from osteoarthropathy after removal of a mixed-cell tumour from the left diaphragmatic lobe of the lung. They were unable to demonstrate regression of the bone lesions radiographically. Brodey and Wind (1957), however, report 2 cases in dogs in which clinical improvement was accompanied by regression of new bone which could be demonstrated radiographically. One of these dogs died with widespread metastases, while the second died after recurrence of neoplasia at the original site. A third dog was still alive at the time the paper was published, having shown clinical regression of osteoarthropathy after lobectomy.

Theories of the aetiology of Marie's disease in man include modification of the endocrine balance by the tumour, and secretion of a specific osteoarthropathy provoking agent by the tumour, but these are not easy to reconcile with the relief following surgery seen in these dogs and described in man. Cudkowicz and Armstrong (1953a, 1953b), however, have found precapillary broncho-pulmonary anastomoses in the lungs of patients with varying degrees of finger clubbing and osteoarthropathy. These were not demonstrable in normal lungs nor in cases of bronchial carcinoma where there was no clubbing. They suggest that an autonomic pulmonary-systemic vascular reflex may be responsible. Impulses from the peripheral nerve fibres of the lung rendered ischaemic by deviation of bronchial arterial blood flow reflexly influence the formation of systemic arteriovenous anastomoses in the limbs, and encourage the laying down of new bone. The fact that relief is given by tumour removal, pulmonary artery ligation, vagus resection and hilum denervation tend to support this theory.

In man, cure of the bony lesions has been permanent after removal of the thoracic neoplasm, and although 11 of Semple's 15 surgical cases died with metastases, only 1 of these showed recurrence of osteoarthropathy (Semple, 1955). He expects that operative results should improve when the significance of the joint symptoms become more generally appreciated. Brodey and Wind (1957) support this view and stress the fact that in many animals the signs of osteoarthropathy appear long before respiratory symptoms ; it is suggested that thickening of the limb bones should always be regarded with suspicion and a careful clinical and radiographical examination of the chest carried out.

(Concluded at foot of adjoining column)

M. A. E. REX.—THE EFFECT OF SURGICAL INTERVENTION IN A CASE OF CHRONIC PULMONARY OSTEOARTHROPATHY IN A DOG

PLATE III.—Radiograph of right foreleg five weeks after operation. Sealing off and resorption of new bone.

PLATE I.—The dog on admission to hospital.

PLATE IV.—The dog five weeks after operation.

PLATE II.—Radiograph of right foreleg on admission.

The Treatment and Subsequent Reinfection of Heifers Infected with *Vibrio fetus*

BY

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AND

D. L. STEWART

Ministry of Agriculture, Fisheries and Food, Cattle Breeding Centre, Reading

SUMMARY.—1. *Sixteen of* 17 *heifers infected with* Vibrio fetus *were successfully treated by intrauterine injections of penicillin and streptomycin on* 3 *consecutive days; the remaining animal was cured on re-treatment. The outcome of the treatment was assessed bacteriologically.*

2. *After treatment,* 13 *of the heifers were reinseminated with semen or sheath washings from infected bulls. Nine animals became reinfected and, of these,* 6 *had been reinseminated with semen from the same bull as was used for the original infection. One heifer became infected after the second attempt at its reinfection but the remaining animals did not become reinfected.*

3. *The effectiveness of treatment and its possible effect on the development of immunity are discussed.*

Introduction

THERE are few reports in the literature where the efficacy of antibiotic treatment of female bovine animals infected with *Vibrio fetus* has been checked bacteriologically.

Easterbrooks and Plastridge (1950) and Plastridge, Williams, Easterbrooks, Walker and Beccia (1951) treated cows that had failed to conceive in known *V. fetus* infected herds by infusing streptomycin and penicillin, or streptomycin alone into the uterus. A few animals were similarly treated with chlortetracycline and oxytetracycline. The authors noted an improvement in the conception rates after treatment, compared with control animals.

Frank and Bryner (1953) treated infected animals with either chloramphenicol, chlortetracycline, oxytetracycline or streptomycin, all in conjunction with penicillin, by injecting the antibiotics into the uterus and vagina. Although there was an improvement in the conception rates after treatment, *V. fetus* was recovered from infected females after treatment with each antibiotic combination. They concluded that a single treatment with the antibiotics failed to eradicate the infection from all individuals, and that natural service could not be used with the assurance that the bull would not become infected from a carrier cow in which treatment failed.

Easterbrooks, Plastridge, Williams and Kiggins (1955), using intrauterine infusions of streptomycin,

TABLE I
TREATMENT COMMENCING 8 WEEKS AFTER INFECTION

Antibiotic used	Route of administration	No. of injections	No. of heifers*	
			Treated	Cured
Penicillin	Intramuscular	5	6	2
	Intrauterine	2	6	4
Streptomycin	Intramuscular	5	6	5
	Intrauterine	2	6	3
Chlortetracycline	Intravenous	5	6	6
	Intrauterine	2	6	6
Chloramphenicol	Intramuscular	5	6	0
	Intrauterine	2	6	0
Thiosemucarbazone	Intrauterine	5	6	1
	Total		54	27

* Six animals left as untreated controls.

*Present address :—Central Veterinary Laboratory, New Haw, Weybridge, Surrey.

The Effect of Surgical Intervention in a Case of Chronic Pulmonary Osteoarthropathy in a Dog—*Concluded.*

Acknowledgments.—My thanks to Miss Jenny Benstead for her patience and nursing care, to Mr. S. W. Douglas for permission to record this case and to all my colleagues at the School of Veterinary Medicine for their encouragement and criticism.

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reported that treated animals conceived after an average of two inseminations less than the untreated control group. Tutt (1956) used streptomycin parenterally for the treatment of infected herds.

Lawson and MacKinnon (1954) infected 60 virgin heifers with a culture of *V. fetus*. All the animals became infected, and treatment, using various antibiotics, was started 8 weeks after insemination. The criterion used for successful treatment was the failure to recover *V. fetus* from the vaginal mucus. Their results are recorded in Table I.

Adler (1957) reported his results on the treatment of 201 females infected with *V. fetus*. His results can be summarised briefly as follows :—

TABLE II

Antibiotic used	Route of administration	No. of injections	No. of heifers	
			Treated	Cured
Streptomycin	Parenterally	1–3	7	0
Streptomycin	Locally	1	14	9
Streptomycin and Penicillin	,,	1	33	9
Streptomycin and Penicillin	,,	2	28	16
Streptomycin	,,	2–3	94	84
Chlortetracycline	,,	1	15	0
Chlortetracycline	,,	2–3	10	4
Total			201	122

The purpose of the investigations, described below, was to determine whether heifers infected with *V. fetus* could be cured by the application of a mixture of penicillin and streptomycin to the uterus and cervix, the outcome of the treatment to be assessed bacteriologically. Furthermore, it was decided to study whether infected females that had been successfully cured could still be reinfected with infected semen. It was hoped that such information might lead to some understanding of the way by which infected females acquire a resistance to the disease and eventually conceive even to known infected bulls.

Materials and Methods

i. *Infected Heifers*

These consisted of heifers that had been shown to be infected with *V. fetus* during diagnostic work already reported (Morgan, Melrose & Stewart, 1958). The media used for primary isolations and the techniques used for the biochemical identification of the organism were as described earlier (Morgan, 1957).

ii. *Method of Treatment and Reinfection*

The antibiotic mixture, with which each animal was treated, consisted of 2 g. streptomycin and 1 million units penicillin, in an oily base, the total volume being 50 ml.

Corpora lutea were expressed from the heifers, and at oestrus, which normally occurred 3 days afterwards, each heifer was treated with 50 ml. of the antibiotic mixture which was injected by means of a uterine catheter into each horn of the uterus and into the cervical canal. The injection was repeated on each of the 2 succeeding days.

A week after the commencement of the treatment, vaginal mucus samples were collected from the

TABLE III

SUMMARY OF RESULTS OF TREATMENT AND REINFECTION

Heifer No.	Original infection			Treatment		Reinfection		
	Date	Semen used for insemination	Cultural examination of vaginal mucus for *V. fetus*	Date	Cultural results for *V. fetus*	Date	Semen used for re-insemination	Cultural results for *V. fetus*
47	11. 5.56	Bull E.D.	+	18. 6.56.	–	7. 9.56†	Sheath washings of Bull D.H.	–
63	27. 4.56	Bull D.H.	+	18. 6.56	+			
				(retreated 3. 8.56)	–	7. 9.56‡	Bull D.H.	+
91	17. 6.57	Bull E.D.	+	30 9.57	–	6.12.57	Bull D.H.	–
106	16.11.56	Deep frozen Semen	+	20.12.56	–	19. 7.57‡	Bull E.D.	+
109	24. 9.56	Bull B1	+	5.11.56	–	19. 7.56	Bull E.D.	+
115	27. 4.56	Bull E.D.	+	18. 6.56	–*	7. 9.56†	Sheath washings of Bull D.H.	–*
				7.11.56	–*	5. 7.57†	Bull E.D.	–*
132	24. 9.56	Bull B2	+	5.11.56	–	5. 7.57‡	Bull E.D.	+
143	17. 6.57	Bull E.D.	+	30. 9.57	–	6.12.57	Bull D.H.	+
148	15. 3.57	Bull E.D.	+	17. 6.57	–	4.10.57	Bull E.D.	+
149	15. 3.57	Bull E.D.	+	17. 6.57	–	4.10.57	Bull E.D.	+
150	19.10.56	Deep frozen Semen	+	20.12.56	–*	5. 7.57	Bull E.D.	–
						4.10.57†	Bull E.D.	+
152	17. 6.57	Bull E.D.	+	30. 9.57	–	6.12.57	Bull D.H.	+
153	15. 3.57	Bull E.D.	+	17. 6.57	–	11.10.57	Bull E.D.	+

* = Catalase-negative vibrios recovered.
† = Heifer not in oestrus at time of insemination.
‡ = Heifers gave reaction to mucus agglutination test at time of reinfection.

heifers and cultured on thio blood-agar plates. The effectiveness of the treatment was based entirely on the results of the bacteriological examinations.

A period varying from 5 to 12 weeks elapsed between the time of the original infection and the commencement of the treatment, and 12 to 30 weeks between the time of treatment and reinfection, except in the case of heifer 63 where a period of a month elapsed between treatment and reinfection.

An attempt was made to reinfect 13 of the 17 successfully cured animals with the semen or sheath washings from a known infected bull and, whenever possible, the materials used for the original infection and for the reinfection were from the same bull. This, however, was not possible in all cases, as bulls were often treated after the original diagnosis had been made. After the reinfection, vaginal mucus was collected and cultured for vibrios.

Results

The results of the treatment and reinfection are summarised in Table III and the results of treatment only of a further 4 heifers are given in Table IV.

TABLE IV
TREATMENT OF FURTHER 4 HEIFERS

Heifer No.	Original infection			Treatment	
	Date	Semen used for insemination	Cultural examination of vaginal mucus for *V. fetus*	Date	Cultural results for *V. fetus*
114	11.10.57	Bull E.D.	+	7.2.58	—
118†	11.10.57	Bull E.D.	+	7.2.58	—
137	11.10.57	Bull E.D.	+	7.2.58	—*
140	11.10.57	Bull E.D.	+	7.2.58	—

* Catalase negative vibrios recovered.
† Heifer gave positive reaction to mucus agglutination test prior to treatment.

Vaginal mucus from all the heifers was cultured for at least 2 months after treatment. In many cases, examinations were carried out over a longer period. In the first series, 12 of the 13 heifers were successfully treated, based on the failure to recover the organism after treatment; the remaining heifer (No. 63) was also successfully treated by a second application of the antibiotic mixture 2 months later. Non-pathogenic (catalase negative) vibrios were recovered from the vaginal mucus of 2 of the heifers after treatment. All the 4 heifers in the second series were successfully treated, but reinfection was not attempted in these cases.

All the heifers remained free of infection for periods varying from 6 weeks to 8 months, thus showing that a permanent cure was effected.

In the first series, 4 heifers—Nos. 63, 106, 109 and 132—gave reactions to the mucus agglutination test around the time of the reinfection. All the other heifers gave negative mucus agglutination reactions and continued to remain negative throughout the observation period, although some were culturally positive.

Three heifers—Nos. 47, 115 and 91—which had been previously infected and successfully treated, did not again become infected when reinfection was tried experimentally. Cultural examinations of vaginal mucus were all negative for *V. fetus*. Heifers 47 and 115 were inseminated with sheath washings, and Nos. 91 and 115 with semen from infected bulls; two of these heifers were not actually in oestrus at time of insemination. Catalase-negative vibrios were, however, recovered from the vaginal mucus of heifer No. 115 both after the treatment and after reinfection.

Catalase-negative vibrios were also recovered from the vaginal mucus of heifers 137 and 150 immediately after the treatment. When heifer 150 was reinfected with semen of bull ED on July 5th, 1957, cultural examinations were completely negative for both *V. fetus* and catalase-negative vibrios, but, on subsequent reinfection on October 4th, 1957, *V. fetus* was recovered from the vaginal mucus.

All the remaining heifers became reinfected, based on the recovery of *V. fetus* from the vaginal mucus.

Discussion

V. fetus in the female bovine animal causes a temporary infertility, and a high proportion of such infected cows eventually conceive even to a known infected bull. It follows, therefore, that infected females must be treated in the early stages of the disease before tolerance has been acquired, but it poses the question as to what criteria should be used for a treatment to be judged successful. Is the criterion to be a "physiological" cure, *i.e.* ability to conceive normally, or a bacteriological cure?

In the present work, a bacteriological criterion was used, animals being judged to be successfully cured based on the failure to recover *V. fetus* from vaginal mucus. Under these conditions, 16 of 17 animals were cured by the local application of streptomycin and penicillin and the remaining animal was cured on re-treatment 2 months later. The fact that one infected animal in the first series was not cured after the first course of treatment is of great importance, especially where animals in an infected herd are treated. Unless the effectiveness of treatment is checked, there is no guarantee that a clean bull could not become infected if allowed to serve such treated animals. This fact has already been stressed by Frank and Bryner (1953).

With the limited number of infected heifers available for treatment studies, it was not possible to assess either the value of other antibiotics or the effect of the stage of the oestrous cycle on the treatment. According to Adler (1957) the success of the treatment was not dependent on the stage of the oestrous cycle when treatment was commenced, and streptomycin alone was as effective as streptomycin plus penicillin. However, 2 or 3 applications were more effective than one, and he found streptomycin applied locally to the uterus was far more effective than chlortetracycline. This is in marked contrast to the result reported by Lawson (1954) who found that chlortetracyline was more effective than streptomycin, and also that chlortetracycline was the only antibiotic that was effective when applied paren-

terally. Such a method of treatment could be of considerable practical value if all the animals in a herd had to be treated.

The results, herein reported, show that, in the case of heifers infected with *V. fetus* and then bacteriologically cured, *V. fetus* was still able to establish itself in the genital organs of a proportion of such heifers irrespective of whether they had specific vaginal mucus agglutinins or not. However, no fertility data were available for the animals used in these studies although such data would have been of considerable interest. In this connexion, it is interesting to recall the fertility data obtained by Lawson and MacKinnon (1956) in the case of cured and infected animals. Twenty-seven infected and cured animals required 1.6 inseminations per pregnancy using semen from a known clean bull, whereas 27 infected animals which were not cured required 5.4 inseminations per pregnancy using semen from the same clean bull. The difference between the number of inseminations per pregnancy in the cured and infected animals suggests that a bacteriological cure will allow normal conception to occur. But animals still infective can also conceive, as shown by the recovery of the organism from pregnant animals and from animals after a normal gestation (Lawson & MacKinnon 1953; Frank & Bryner, 1953). The observations from the present investigations show only that treated heifers can still be reinfected and become infective. It is possible, therefore, that an infected and cured animal would, on reinfection with infected semen, still become pregnant and yet harbour the organisms in the genital organs.

Another observation of interest brought out by the present work was that infected heifers, which gave positive mucus agglutination reactions before treatment, continued to give positive reactions during the subsequent period of treatment and reinfection. Heifers which were negative to the mucus agglutination test prior to treatment, remained so during the subsequent observation period even though they were culturally positive due to reinfection during the latter period.

Harrison (1946) studied the effect of antibiotic therapy on the immune response of rabbits to pneumococcal infection. He showed that rabbits infected with pneumococci and treated with penicillin during the first 4 hours afterwards did not develop clinical infection nor did they produce serum antibodies.

It is possible that, in the present work, some of the heifers did not produce vaginal mucus agglutinins because the antigenic stimulus was removed, by treatment, too early. The interval between the original infection and treatment was, however, approximately the same in the animals that did, and those that did not, develop agglutinins.

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(*Concluded at foot of adjoining column*)

An Apparatus for the Maintenance of Intravenous Drip in the Conscious Dog

BY

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IN the course of research work on water metabolism in the dog an apparatus was devised whereby an animal could be given a continuous infusion of fluid for several days (Jewell, 1957). Dogs harnessed to this apparatus were able to move about freely within the boundaries of a fairly large kennel. They did not resent its presence and showed no evidence of discomfort. Furthermore, the infusion continued without interruption in spite of the many different postures the dog assumed; it was only necessary to refill the reservoir bottle periodically. In view of this it was felt that the apparatus could be adapted for clinical use in cases where it was considered desirable to administer intravenous fluids at a slow and steady rate in an unanaesthetised dog.

The apparatus was modified, as shown in Fig. 2, to hold an infusion bottle with a standard M.R.C. "giving-set" attachment, by means of which the bottle was connected to a polythene delivery tube running through the apparatus. The screw-clip on the rubber tubing beneath the drip-chamber facilitated control of the rate of drip infusion.

The essential feature of the apparatus was a counter-weighted pulley system which allowed a wide range of movement to the animal (see Figs. 1 and 2). It consisted of appropriate pulley wheels and guides, and the coiled-wire part of a bicycle Bowden brake-cable casing (Fig. 1 (*a*)) the outer layers of plasticised material having been stripped off to give the remaining casing greater flexibility. A fine polythene tube (*b*) was passed through the casing in place of the brake cable. At its upper end this tube was held in a metal polythene-tubing adaptor (*c*), brazed to the top pulley block, which made connexion to rubber

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tubing (*d*, from the drip apparatus) simple. The lower end of the delivery tube was attached to a modified dog harness (*e*) by means of a brass plate (*f*) and brass block (*g*). The brake cable casing was firmly fixed in this brass block by a grub screw. The polythene tube passed out of the casing and

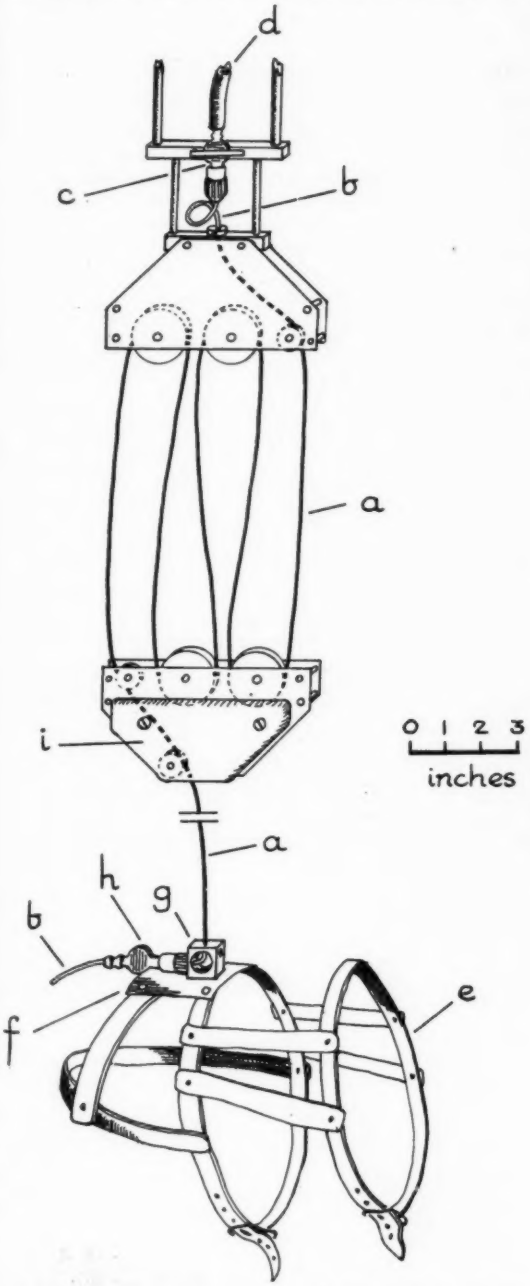

FIG. 1.—Drawing of apparatus and attachments. Some minor features are slightly exaggerated in size to show details. For explanation see text.

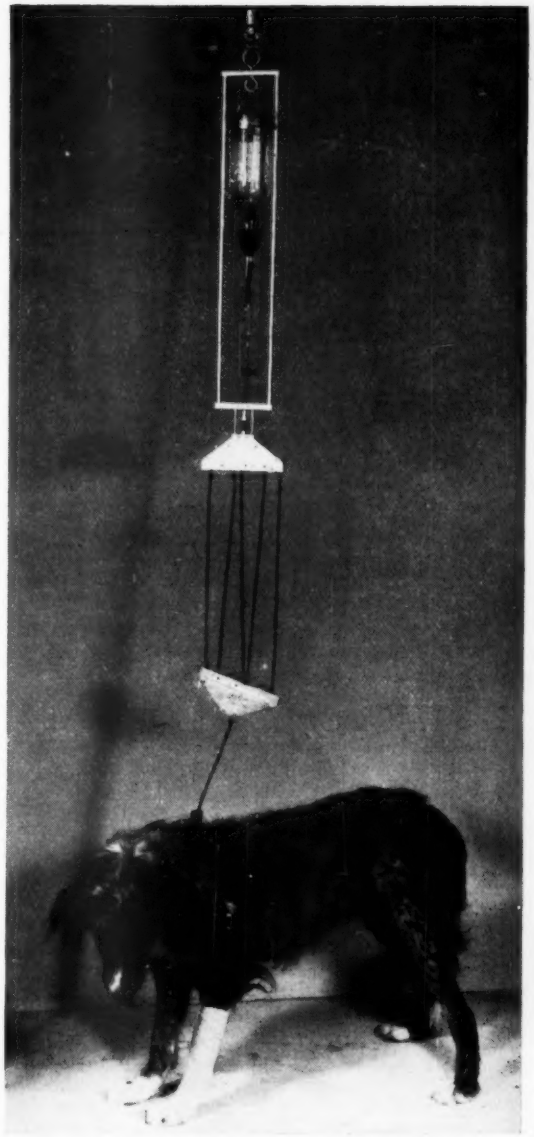

FIG. 2.—Apparatus with drip bottle attached. In normal use the apparatus is adjusted to give a greater distance between the pulley and the animal.

through a polythene tubing adaptor (*h*) brazed to the brass block; its protruding end was then connected by rubber and polythene tubing to the intravenous needle.

In normal use the apparatus was suspended higher above the animal than is shown in Fig. 2, and the encased tubing between the pulley system and the harness was passed through a "guide" in order to keep the pulleys vertical. This "guide" was merely a smoothed brass ring, and could be fixed in the top of a small cage or to a bracket in a kennel. The

polythene tubing, connecting the delivery tube from the point of attachment at the harness to the vein, had the terminal end bent into a "U" shape. This was fitted to a record needle adaptor that in turn was attached to a 19-B.W.G. needle, 1 to 1½ inches in length, inserted into the cephalic vein. The limb was bandaged so that as the animal moved about disturbance of the needle and tubing was prevented.

The whole apparatus was suspended at the top on a swivel which can just be seen in the photograph. The lower pulley block was weighted with lead (*i*), a 3-lb. weight appearing most suitable.

Sterilisation

Since the apparatus could not be boiled or autoclaved, sterilisation was effected chemically using the following methods*:—

After use, the tubing system was drained and then flushed with a 0.1 per cent. aqueous solution of trimethyl alkyl ammonium bromide,† care being taken, as with all the solutions used, to see that the drip chamber was completely filled. This was followed by flushing the system with sterile distilled water. Then the tubing was filled with bis-parachlorophenyl—diguanido hexane diluted with sterile distilled water or industrial methylated spirit to a strength of one part of the "concentrate" in 100 parts of the diluent. A sterile piece of rubber tubing fitted with a screw-clamp was attached to the end of the polythene tubing to keep this solution in the system. Thus treated, the apparatus was stored until required for further use, but sterilisation was complete after storage for half an hour.

Occasionally it was necessary to sterilise the apparatus more rapidly. This was done by washing and rinsing the apparatus as described above, and then filling the system with an 0.5 per cent. solution of "Hibitane" diacetate in industrial methylated spirit. This solution will kill all vegetating organisms in 15 seconds, but to give a wide margin of safety it was left in contact with the lining of the apparatus for at least one minute.

Before use, the sterilising fluid was drained from the apparatus. Thorough rinsing with sterile distilled water was then carried out and, finally, the system was flushed and filled with the fluid to be infused. The giving set was sterilised by boiling in the usual way.

The effects of these procedures on the polythene tubing was tested by examining similar tubing after continuous immersion in the solutions described above for one month. The flexibility, colour, outside diameter, inside diameter, and wall-thickness remained unaffected.

Clinical Use of the Apparatus and Discussion

The apparatus was used for the post-operative administration of saline and/or dextrose solutions in 8 clinical cases. When harnessed to the apparatus the animals were able to recover from the anaesthetic and become ambulant without interfering with the slow drip infusion. One dog began to chew the bandage after 2 hours and the infusion was then discontinued. The others took no notice of the presence of the apparatus.

The infusion was continued at a rate of 8 to 16 drops per minute for periods varying from 2 to 48 hours, *i.e.* until fluids could be taken satisfactorily by mouth. With the longer periods, however, there was a tendency for the limb to become oedematous. If, therefore, the infusion were to continue for several days, it would be advisable to cannulate the jugular vein.

All the cases which were given intravenous fluids in the manner described, were in a dehydrated and toxic condition when presented for surgery. Two of them died 2 days after operation. One case, however, recovered after being admitted in a comatose state with toxic pyometritis. This was an 8-year-old Pekingese bitch, and here the infusion was continued for 36 hours after operation. It is thought that the infusions, along with a carefully balanced anaesthetic technique, greatly assisted the recovery of the 6 dogs which survived.

The apparatus was simple to use, and required little attention. The animals were inspected at hourly intervals, except overnight, when they were left unattended for 6 hours. Special care, however, was taken to see that the infusion bottle did not become empty as there would then have been a risk of air embolism. This risk could be obviated, by the use of a Macintosh "Safety Dropper," where a glass "bobbin" in the drip chamber prevents entry of air into the tubing below the dropper, in the event of the bottle becoming empty.

In conclusion, it is suggested that this apparatus may have a useful place in the small-animal surgery, for the maintenance of intravenous infusions in the unanaesthetised animal.

Acknowledgments.—We would like to express our thanks to Professor C. Formston and Mr. G. C. Knight for the facilities extended to us for the use of this apparatus in the Beaumont Animals' Hospital.

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* Suggested by Imperial Chemical Industries Ltd.
† Cetavlon.
‡ Hibitane concentrate (Chlorhexidine B.P.).

Current Literature

REPORT

Report on the Animal Health Services in Great Britain, 1957. Ministry of Agriculture, Fisheries and Food. Department of Agriculture, Scotland. London. H.M.S.O. 6s.

Once more our colleagues in the Ministry of Agriculture issue their report on the Animal Health Services in Great Britain. This report refers to their activities in 1957, and at times one wishes that the delay in publication was not quite so long, but when

one considers the extensive and detailed information in these annual reports the delay is understandable.

On the whole 1957 was similar to 1956 as far as the major diseases were concerned. Foot-and-mouth disease followed the same pattern with 184 outbreaks, the majority of which occurred in the latter half of the year. Over a third of the primary outbreaks were attributed to spread from the Continent, where, in France particularly, the disease was rife. After the exceptionally high incidence of anthrax in 1956 (1,245 outbreaks), it fell in 1957 to a more normal level of 318 outbreaks. Feeding-stuffs and fertilisers continued to be the most frequent source of infection. The majority of outbreaks (276) involved the death of a single cattle. There were 39 outbreaks in pigs and in the remaining 3 incidents a horse, a hound, and two mink were affected. The horse and the mink carcases had been opened, as well as 27 cattle and 10 pigs.

The incidence of swine fever was somewhat higher than in 1956, with 960 outbreaks, but this was still below the level of most recent years.

Outbreaks of fowl pest continued to increase; about two-thirds of them occurred in Lancashire, but on the other hand 33 counties in England and Wales were free of the disease. Scotland had a number of outbreaks after 6 years' freedom from infection.

At the time of writing the reports about three-quarters of all cattle in Great Britain were attested and subsequent information has made it clear that total eradication of tuberculosis in cattle is in sight.

The issues of Strain 19 for the vaccination of calves and maiden heifers against infection with *Br. abortus* maintained their previous levels, but it is suggested that far more could be used.

There is the usual information on the control of imports and exports of animals and their products including some discussion on the report of the Committee set up to investigate the export of cattle to the Continent.

However, despite the wealth of factual detail in the first four parts of the report, it is in Part V that the real interest lies, for in the accounts of laboratory, research, and investigation services almost all aspects of health and disease in farm animals are mentioned. The amount of material and its intrinsic interest defeats any hope of adequate review, and only an arbitrary selection of projects for mention is possible.

It is encouraging to read that a pilot scheme in a number of herds for the eradication of brucellosis was begun, paying particular attention to tests for differentiating between vaccinal and infection titres. Work of this kind is an essential preliminary to any more ambitious national scheme, which may be the profession's next big task in preventive medicine.

The results are given of 10 years' field trial of Johne's disease vaccination. In the earlier years the difference in incidence of the disease in vaccinated and control animals was clear, but in the last year it was not so. Whether this is a reflection of a concomitant decrease in infection in the herds as a whole resulting in reduced risks to unvaccinated animals, is not stated.

About 10 per cent. of no lesion tuberculin reactors in cattle yielded bovine tubercle bacilli, and in approximately 25 per cent. of the negative specimens parasitic and suppurative lesions with marked tissue reaction were present. Breakdowns in 2 attested herds were traced to infection with human type tubercle bacilli, and there was a known infected person working in contact with the cattle on both farms.

The results of examining mastitis samples still emphasise the importance of staphylococcal infections and the continuing decline in the numbers of *Str. agalactiae* infections. Attention is drawn to the much wider variety of bacteria which were recovered from cases of clinical mastitis.

Experimental work on the epidemiology of staphylococcal mastitis continued and the results are likely to lead to a much better understanding of this type of mastitis.

Although results with the gel diffusion precipitin test for the laboratory diagnosis of swine fever continued, it is clear from the report that it could not be regarded as sufficiently accurate at that stage to justify hopes that it would be the answer to swine fever laboratory diagnosis by itself.

The work on the association between certain serotypes of *E. coli* and oedema disease and enteritis in young pigs is of great interest and as a result new and fundamentally important approaches to these and similar problems in other young animals can be expected.

Among mycological recoveries it is interesting to note that a number of extensive outbreaks of ringworm in horses have been investigated.

Readers will have detected a certain microbiological bias in the selection of material; to some extent this reflects your reviewer's leanings, although much of the work reported is in this field. Nevertheless, there is much to interest the poultry specialist, the parasitologist, and the biochemist. At random the following headings come to mind: lungworms in cattle and sheep, including their treatment in field trials, hypomagnesaemia, acetonaemia, hypocuprosis, and high level copper feeding, chemotherapy of coccidiosis, the treatment of bracken poisoning with batyl alcohol, and artificial insemination in pigs.

The prize for the most exotic finding of the year must be given for the recovery of *Salmonella stanleyville* from the intestines of a scimitar billed babbler.

One would crave indulgence for a minor complaint. It grieves one to find this excellent report bespattered with the adjective "bovine" masquerading as a noun. Really, Tolworth and Weybridge should know better.

It is true to say that nearly every subject mentioned has a more or less direct bearing on the interests of the clinician, and few specialists will fail to find something concerning their own field in this fascinating and comprehensive account of the activities of Her Majesty's civilian veterinary staff. D. L. H.

ABSTRACTS

A Clinical and Radiological Study of Canine Bone Neoplasms. BRODEY, R. S., MCGRATH, J. T., & REYNOLDS, H. (1959). *J.A.V.M.A.* **134.** 53, 71.

One of the most comprehensive reviews of bone neoplasms in the dog is presented by the authors following a study of the subject in an attempt to supplement the literature and stimulate interest in these lesions. A detailed description is given of the tumours as they occur in each bone of both the fore- and hind legs. In addition tumours occurring on the ribs, sternum, nasal area, mandible, cranium, and vertebrae, are also dealt with in detail. A comprehensive table is given summarising 75 cases of bone tumours presented at the veterinary clinic of the University of Pennsylvania. This covers a period of 6 years. Of these cases, 31 were diagnosed clinically and radiologically, the remainder being diagnosed histopathologically.

In the opinion of the authors primary bone neoplasms affect the large breeds of dogs almost exclusively—the Great Dane in particular having a tremendous predisposition to osteosarcomas of the long bones. Doubt is expressed as to whether trauma plays any rôle in the aetiology of these tumours, but it is significant that twice as many tumours were observed on the forelegs (which bear 10 per cent. more weight than the hind legs) as were found on the hind legs.

A further article on the pathology of canine bone neoplasms is in the course of preparation.

J. S. J. L.

Ureterocolostomy for Relief of Urinary Stenosis in the Domestic Cat. BEAMER, R. J. (1959). *J.A.V.M.A.* **134.** 201.

Surgical procedures designed to relieve urinary stenosis in the domestic cat were carried out on 10 apparently normal cats. A direct ureterocolostomy was established in 5 animals, but all died on or before the fifth day. A piece of bladder ½ inch square and adjacent ureters were transplanted into the colonic wall of one cat which died 4 days later. The remaining 4 cats had the urethra transplanted into the wall of the colon with apparent surgical success, although 1 cat died on the fourth post-operative day due to peritonitis. The 3 cats successfully operated upon appear normal with semi-solid faeces passed 2 or 3 times daily. One cat has survived 5 months.

The neck of the urinary bladder was ligated and transected immediately anterior to the prostate gland and an opening was made into the colon. A piece of plastic tubing of small bore was passed through the colonic opening into the lumen of the colon, out through the anus, and sutured to the skin to retain it in position. The other end of the plastic tube was passed through the neck of the bladder and into the fundus of the urinary bladder. The neck of the bladder was then sutured to the opening in the colon. The tube was allowed to remain in place for 7 days before removal.

C. F.

Failure to Produce Vibriosis in Cattle by Vulvar Exposure. MCENTEE, KENNETH, HUGHES, D. E., & WAGNER, W. C. (1959). *Cornell Vet.* **49.** 34.

These studies were carried out because of conflicting evidence that infection with *Vibrio fetus* may occur by contact as well as by natural service and by artificial insemination.

Heifers were deemed infected when *V. fetus* was cultured from their cervical mucus and/or agglutinins to this organism were demonstrated in their vaginal mucus. Only heifers which gave negative reactions to both these tests on a number of occasions were used in the experiments. The pathogenicity of the strains of *V. fetus* employed was first confirmed by their ability to infect all of 4 heifers following intra-uterine injection.

Eight heifers were then treated by pouring a broth culture of *V. fetus* over the vulval cleft and rubbing it over the labia with a cotton plug, the organisms thereby being deposited 2 to 3 cm. within the vulva. This procedure was carried out 2 to 3 times at 5- to 7-day intervals at various stages of the oestrus cycle. Cervical and vaginal mucus was examined several times during a period of 3 months following exposure but none of the heifers was found to have become infected.

To confirm that the heifers were still susceptible to infection at the end of the 3-month period, they were injected intrauterinally with a broth culture of the strain of *V. fetus* to which they had previously been exposed. Seven of the 8 contracted this infection.

As a result of these experiments the authors concluded that the chances of *V. fetus* spreading by contact are remote.

H. W. S.

Myopathies in Dogs. MEIER, H. (1958). *Cornell Vet.* **48.** 313.

Meier classifies myopathy, a primary non-inflammatory degeneration of striated musculature, as a progressive muscular dystrophy and discusses the condition in man. He then reviews the veterinary literature covering the myopathies of scrapie, stiff-lamb disease, white muscle disease of calves and pigs, muscular dystrophy of foals, canine myopathy, nutritional muscular dystrophy of laboratory animals, and other less known conditions. He describes the symptoms, gross pathology, and histology of 3 cases of canine myopathy with which he was concerned at the Angell Memorial Hospital, Boston. Two cases showed muscular wasting and weakness, the third enlargement of the tongue and the musculature of the neck and shoulder. At autopsy the common feature was pallor of striated muscle, in particular the diaphragm. Microscopic examination is fully described and in the first 2 cases indicated degeneration of striated muscle fibres, in the third both muscle necrosis with connective tissue reaction and calcification and muscle hypertropy were present. Causation and treatment are discussed and compared with polymyositis of man; no causal agent could be determined in cases 1 and 2 but vitamin E deficiency is suggested in the third although all other members of the litter appeared normal. Treatment with antibiotics and steroids proved unsuccessful, and an evaluation of treatment in man indicated no benefit except from orthopaedics and physiotherapy.

W. B. S.

News and Comment

OFFICIAL OPENING OF NEW POULTRY LABORATORIES

On Wednesday last, May 13th, the new laboratories of the Houghton Poultry Research Station were officially opened by Lord Rank, Chairman of the Animal Health Trust. Our readers will recall that the Station was established in 1948 by the Trust, and that recently the Agricultural Research Council arranged to collaborate in its maintenance and working. It must have been a source for legitimate pride to Dr. W. R. Wooldridge, the founder of the Trust, to see how remarkably his original plan had matured; for the new laboratories, forming an additional wing

to the original Houghton Grange are beautifully built and equipped, and will make possible a considerable expansion of the work undertaken hitherto.

The new wing, however, does not complete the plan for the whole Station. It is intended later on to develop on an adjoining 40-acre field a unit which will be operated under the most rigid conditions of hygiene (in fact, a miniature Pirbright) where it is intended to carry out investigations into the leucosis complex and fowl paralysis, a group of diseases responsible for more economic loss to poultry in this country than most other diseases put together. The unit will have its own staff and as far as is humanly possible will operate separately from the main Station, except in administration.

At the opening ceremony the B.V.A. was represented by Dr. D. F. Oliver, Honorary Secretary, and other guests of note were representatives of the Ministry of Agriculture, the Agricultural Research Council, and the poultry industry.

On being shown round the new laboratories—which include among their amenities a fine library—one was struck immediately by their space, light, and tasteful decoration. Those responsible for the latter had decided, clearly, that because scientific work is carried on, no need exists for the surroundings to resemble a dungeon. The equipment, too, seemed to be ample, and the best of its kind available.

So much work is being done, that it seems invidious to quote special examples. But from its beginning this poultry research station has had a strong practical bias, and veterinary surgeons in practice would have been interested to see work on some of the following:—

On the biochemical side research is going on to discover the relationship between nutrition and infection. Firm conclusions cannot yet be drawn, but it

has been shown generally that the less complicated food compounds tend to reduce mortality, and that among these whole oats give a surprising degree of protection against certain bacterial and protozoal diseases. Other experiments, on additives, have established the fact that 50 grammes per ton of terramycin increased egg production by some 10 per cent., the results being most marked in cold weather. The efficiency of food conversion is greater also. These experiments agree with those carried out elsewhere, though in this case experiments were carried out on an individual bind basis.

The addition of an antibiotic to food has led to work along different lines; and as was feared it has been shown that such supplementation leads to the evolution of resistant strains of bacteria. It has been suggested that the poultry industry might find itself faced with a choice between the use of antibiotics for growth promotion, or therapy; in any case it seems that new antibiotics should be reserved for clinical use, lest the problem of resistant strains gets out of hand.

The practical possibilities of immunity against coccidiosis are under close consideration. Certain experimental surgical techniques and histo-chemical studies are being made in this connexion. It will be recalled that the scientists at Houghton were responsible for elaborating a vaccine for protection against fowl typhoid, and that this substance has had notable success in the field over the past 8 months.

The current work of the bacteriological section is concerned with the study of bacteria causing embryonic mortality and reducing hatchability. This is a point of considerable economic importance to the hatchery industry. A point of interest is that losses in newly hatched chicks have on occasion been found to be associated with *Staphylococcus aureus* infections, in some instances apparently of human origin. The importance of this work both to the hatchery and to the operators needs no emphasis.

Of great interest was the calorimeter, designed at the Station, whose purpose is to establish the air condition, warmth and moisture needed in the ideal broiler house. The working of this machine is a positive miracle of mechanical and electrical ingenuity; and as a final touch it includes an automatic camera which photographs the recording dials at set intervals, so that there is no need for staff constantly to watch results.

In declaring the new laboratories officially open Lord Rank referred briefly to the history of the Research Station, to its early difficulties and the manner in which they had been overcome, and to the scope and value of the scientific work, which has contributed so notably to the advancement of the poultry industry. In reply the director, Dr. R. F. Gordon, paid tribute to Lord Rank's great services to the Animal Health Trust, and to the courage and vision of Dr. Wooldridge, its founder and scientific director. His words were well justified. Looking at it now, it is hardly possible to realise that this Station began from nothing only 11 years ago; it reflects the greatest credit upon those who created it, and have subsequently kept it in the forefront of poultry research.

THE ROYAL SOCIETY OF HEALTH CONGRESS

The increased interest over the past few years in the deliberations of the Veterinary Hygiene Section at the Royal Society of Health Congresses was well in evidence at the 66th Annual Congress held at Harrogate on April 29th, when over 550 representatives of the various bodies interested in public health were in attendance. It was extremely gratifying to the organisers to note the largest veterinary attendance to date present at such a meeting.

The section met under the Presidency of Mr. W. Tweed, F.R.C.V.S., D.V.S.M., F.R.S.H., Ministry of Agriculture, Fisheries and Food. He welcomed the large audience and in particular Lt.-Col. J. A. Dixon, M.R.C.V.S., who, although in his 80th year, was still a very active Fellow of the Royal Society of Health (Lt.-Col. Dixon received a great ovation when he later took part in the discussions.) Mr. Tweed was thanked for his presidential address by Mr. H. B. Allan, M.R.C.V.S., D.V.S.M., F.R.S.H., Harrogate, who reminded the audience of the very important part played by Mr. Tweed in matters connected with all branches of public health in the profession, and expressed the congratulations and best wishes of the audience to him on his recent election to the Council of the Royal Society of Health.

The Veterinary Hygiene Section was extremely fortunate this year in having two eminent speakers, and this, together with the subjects for discussion, no doubt contributed to the success of the meeting.

The first paper, "Bovine Tuberculosis; The End in Sight," was given by Mr. J. N. Ritchie, F.R.C.V.S., B.SC., D.V.S.M., F.R.S.E., Chief Veterinary Officer, Ministry of Agriculture, who gave a comprehensive and detailed account of the progress of the Area Eradication Plan which is now progressing towards its completion.* Mr. G. N. Gould, J.P., M.R.C.V.S., of Southampton, formerly opened the discussion on this paper and was followed by several other speakers who praised the work of the Ministry in the speed with which tuberculosis is being eradicated from the British Isles.

The second paper, "The Slaughterhouses Act, 1958," delivered by Mr. Philip B. Dingle, C.B.E., LL.M., was also of the highest quality and was well received by the large audience. The discussion on this paper, which was opened in a most efficient way by Mr. R. V. Blamire, M.R.C.V.S., D.V.S.M., Ministry of Agriculture and Fisheries, brought to the rostrum many people in all walks of Public Health life who raised many interesting and controversial points.

As has become the custom in recent years, the conclusion of the meeting was followed by an informal gathering of the veterinary surgeons present, and on this occasion it took place over a very enjoyable lunch, arranged by Mr. G. S. Powley, M.R.C.V.S., President of the Yorkshire Division of the B.V.A.

* It is hoped to publish a full summary of the papers in THE VETERINARY RECORD in due course.

R.C.V.S. CEREMONY AT INTERNATIONAL VETERINARY CONGRESS

By the consent of the Organising Committee, the President of the Royal College of Veterinary Surgeons will bestow the award of Honorary Associate of the College during the International Veterinary Congress in Madrid next week. Those to be honoured are: Professor E. C. Amoroso, Professor P. Carda, Professor C. Sanz Egana (deceased), Dr. K. V. L. Kesteven, Professor L. Seekles.

The ceremony will be at the end of the session on Nuclear Energy on the afternoon of Thursday, May 21st. The President hopes that all members of the Royal College attending the Congress will be present.

IN PARLIAMENT

Stilboestrol and Hexoestrol

On May 11th, LIEUT.-COL. BROMLEY-DAVENPORT asked the Minister of Agriculture, Fisheries and Food, in view of the warning issued by his Department that such substances as stilboestrol and hexoestrol, used by farmers for the caponing of poultry and the fattening of livestock, could have a serious toxic effect on man even when small amounts are swallowed or inhaled, what steps are being taken to ensure that the warning issued to farmers is properly appreciated by all sections of the public.

MR. JOHN HARE: My hon. and gallant Friend will appreciate that the warning to which he refers relates to the dangers which could arise from the presence of these substances on the farm and their handling in the course of administration to animals. The materials are not freely available to the public. For these reasons, the warning was primarily addressed to farmers, but the statement has been issued to the general as well as to the farming Press.

RETIREMENT OF SIR EDMUND HARWOOD, K.B.E., C.B.

Sir Edmund Harwood, K.B.E., C.B., Deputy Secretary, Ministry of Agriculture, Fisheries and Food, is retiring from the public service on May 31st, 1959.

Sir Edmund Harwood joined the staff of the Paymaster General's Office in 1918 after service in H.M. Forces. He transferred to the Ministry of Food in 1939 where he has remained except for two breaks in 1947 and 1948 when he was seconded to the Ministry of Defence. During 1947 he held the post of civilian director at the Imperial Defence College. He was promoted to the rank of Deputy Secretary in August, 1953, to take charge of the Supply Department of the Ministry of Food. Since the merger with the Ministry of Agriculture and Fisheries in April, 1955, he has been responsible for the majority of the former Ministry of Food divisions.

A further announcement about the appointment of Sir Edmund Harwood's successor will be made later. Pending this appointment the groups of divisions for which he is responsible will report direct to the Permanent Secretary.

R.C.V.S. OBITUARY

We record with regret the deaths of the following members of the profession:—

EVANS, Thomas Maldwyn, 184, High Road, Willesden, London, N.W.10. Graduated December 19th, 1929, at the Royal Veterinary College, London. Died May 2nd, 1959, aged 54 years.

HEPWORTH, Lewis Dyson, 8, Kew Road, Birkdale, Southport, Lancs. Graduated December 17th, 1934, at the School of Veterinary Science, University of Liverpool. Died May 5th, 1959, aged 72 years.

STEWART, Douglas James, Veterinary Dept., Kaduna, N. Nigeria. Graduated June 30th, 1948, at the Veterinary College of Ireland, Dublin. Died in Hospital in Edinburgh, April 27th, 1959, aged 40 years.

PERSONAL

Dr. Alan Robertson, of the Institute of Animal Genetics, Edinburgh, has been awarded the R.A.S.E. Research Medal for 1959 in recognition of his work on the application of fundamental genetical principles to livestock breeding.

Dr. W. M. McKay has been appointed Agricultural Scientific Co-ordinator for the European Region of Cyanamid International but he will still maintain his office in Bush House, Aldwych, London, W.C.2.

Birth

THOMSON.—On March 30th, 1959, Easter Sunday, to Jeane (*née* Corteen) and Angus P. Thomson, M.R.C.V.S., of Greenacre, Alltycnap Road, Carmarthen, a second son.

FOOT-AND-MOUTH DISEASE

Foot-and-mouth disease was confirmed on May 6th among cattle and pigs at Wootton Farm, Newport, and Cheverton Slaughterhouse, Newport, Isle of Wight.

The whole island has been declared to be an Infected Area. Animals may not be moved on the Island without a licence and the holding of markets on the Island is restricted.

COMING EVENTS

May

21st (Thurs.). Annual General Meeting of the Society of Practising Veterinary Surgeons in the Midland Hotel, Manchester, 2.30 p.m.

Ordinary General Meeting of the Royal Counties Veterinary Association in the Education Lecture Room, Reading University, 3.15 p.m.

27th (Wed.). Annual General Meeting of the Sussex Veterinary Society at the Old Ship Hotel, Brighton, 2.30 p.m.

Annual General Meeting of the Southern Counties Veterinary Society at the Red Lion Hotel, Salisbury, 7.30 p.m.

28th (Thurs.). Annual General Meeting of the Supplementary Veterinary Register Division at "The Crown," Brewer Street, Piccadilly, 3.30 p.m.

Meeting of the South Eastern Veterinary Association at Oveney Green Farm, Sundridge, Nr. Sevenoaks, 2.30 p.m.

Annual General Meeting of the Herts. and Beds. Division at the Peahen Hotel, 14, London Road, St. Albans, 7.30 p.m.

30th (Sat.). Annual Dinner and Dance of the Chiron Club at the Hawthorn's Hotel, Bristol, 7 p.m.

June

2nd (Tues.). R.C.V.S. Day. Annual General Meeting at the Royal College of Veterinary Surgeons, 10, Red Lion Square, London, W.C.1, 3.45 p.m.

3rd (Wed.). Annual General Meeting of the Victoria Veterinary Benevolent Fund at 10, Red Lion Square, London, W.C.1, 1.30 p.m.

XUM

General Meeting of the South Wales Division at the Langland Bay Hotel, Mumbles, Swansea, 2 p.m.

Meeting of the North Wales Division at "Cartrefle," Palace Avenue, Rhyl, 2 p.m.

Joint Meeting of the Scottish Branch and the Scottish Metropolitan Division at the Golden Lion Hotel, Stirling, 2.30 p.m.

3rd and 4th (Wed. and Thurs.). Quarterly Meetings of Council of the R.C.V.S.

4th (Thurs.). Meeting of the Western Counties Veterinary Association at the Rougemont Hotel, Exeter, 2.30 p.m.

5th (Fri.). Annual Dinner of the Royal Veterinary College Association at the R.V.C., Camden Town, London, N.W.1, 6.30 p.m.

10th (Wed.). Meeting of the Society for the Study of Animal Breeding in the West Hall of the Royal Society of Medicine, 1, Wimpole Street, London, W.1, 11.30 a.m.

11th (Thurs.). Annual Meeting of the R.A.V.C. Golfing Society at the North Hants Golf Club, Fleet, 10 a.m.

12 (Fri.). Annual Dinner of the R.A.V.C., Officers' Club at Grosvenor House.

13th and 14th (Sat. and Sun.). 7th Annual Reunion and Dinner of the R.V.C. '52 Club at Streatley.

July

15th, 16th and 17th (Wed., Thurs. and Fri.). B.V.A. Committee and Council Meetings in London.

August

30th to 5th September. 77th Annual Congress of the British Veterinary Association in Folkestone. (Official opening Monday, August 31st.)

ADDRESSES OF DISEASE INFECTED PREMISES

The list given below indicates, first the county in which are situated the premises on which disease has been confirmed, followed by the postal address and date of outbreak.

Anthrax

Ayr Perceton Mains Farm, Irvine (May 5).
Salop. Bwlchyrhiw, Llansilin, Oswestry (May 11).

Foot-and-Mouth Disease

Isle of Wight. Wootton Farm, Wootton; Cheverton Slaughterhouse, Shorwell, Newport (May 6); Knights Farm, Wootton; Hill Grove, Wootton, Newport (May 7).

Fowl Pest

Essex. The Molehill, Molehill Green, Felstead, Dunmow; Roselawn Farm, Broomfield, Chelmsford (May 6); 30, Main Road, Broomfield, Chelmsford; Newneys Farm, Fairstead, Chelmsford (May 8); Great Mascalls Farm, Great Baddow, Chelmsford (May 11).
Herts. The Piggeries, Wormley West End, Wormley, Broxbourne (May 9).
Kent. Angar Convalescent Home, Cudham, Sevenoaks (May 5).
Lancs. Openshaw Fold Farm, Radcliffe, Manchester (May 7).
Staffs. Semi-Bungalow Farm, Chemical Hill, Brownhill, Walsall (May 7).
Yorks. Broom Cottage, Bolsterstone, Sheffield (May 9).

Swine Fever

Ches. Ashfield Farm, Chester High Road, Neston, Wirral; Badgers Rake Farm, Ledsham, Wirral (May 6); The Elms Farm, Horton, Malpas (May 11).
Dorset. East Farm, Bradford Abbas, Sherborne (May 7); Piggeries, Loudsmill, Dorchester (May 8); Bedchester Farm, Bedchester, Shaftesbury; Hill View Dairies, Okeford Fitzpaine, Blandford Forum (May 11).
Gloucs. Hill Farm, Ingst, Olveston (May 7).
Kent. Lower Ringlestone Farm, Maidstone (May 5); Rock Farm, Frittenden, Cranbrook (May 8).
Norfolk. Burwood Hall Farm, Mileham, King's Lynn (May 7); Hospital Farm, Mundesley, Norwich (May 11).
Oxford. Wood Farm, Tackley (May 11).
Staffs. Unit Farm, 15, Maintenance Unit, R.A.F. Hixon (May 11).
Somerset. Cholwell Farm, Templecloud, Bristol (May 11).
Suffolk. Morland Road Allotments, Ipswich (May 7).

Letters to the Editor

The views expressed in letters addressed to the Editor represent the personal opinions of the writer only and their publication does not imply endorsement by the B.V.A.

SCIENTIFIC

Protection of Cattle Against the "Neethling" Type Virus of Lumpy Skin Disease

Sir,—In South Africa several types of virus are associated with lumpy skin disease (Alexander, *et al.*, 1957). However, workers in Kenya have found evidence of infecion only by the "Neethling" type of virus (Prydie & Coackley, 1959; Burdin, 1959). "Neethling" virus exhibits certain characteristics of the pox group (Alexander, *et al.*, 1957), and lesions produced by it in bovine animals closely resemble those of sheep pox in sheep (Burdin, 1959; Green, 1959).

Efforts to immunise cattle against "Neethling" type infection using formalinised tissue culture "Neethling" virus, with and without adjuvant, have so far proved unsuccessful. On the other hand, Capstick (1959) reported that cattle were protected against "Neethling" virus following intradermal inoculation with live sheep pox virus ("Isiolo" strain).

A small pilot experiment was carried out with the "Kedong" strain of sheep pox (MacOwan, 1956), obtained from the Director, East African Veterinary Research Organisation. This strain had been adapted to cell culture (Plowright & Ferris, 1958), and had been subjected to 8 tissue culture passages when received at this Laboratory. After 2 passages of this virus in sheep, 2 cattle were inoculated intradermally at 4 sites on the thorax with $10^{2.5}$ sheep skin ID_{50}. All 4 sites reacted showing an erythematous area which later became necrosed and separated from the

surrounding skin. Two other cattle that received $10^{1.2}$ ID_{50} intramuscularly showed no apparent reaction. A suspension of a lesion from one of the reacting intradermal sites was passaged by intradermal and subcutaneous inoculation into 2 further cattle; these showed intradermal thickening after 6 days, which regressed without forming necrotic lesions. All 6 animals were subjected to intradermal titration challenge by cattle-passaged "Neethling" virus within 34 days of initial inoculation and were found to be immune. Challenge material titrated intradermally on 2 control animals reacted at a mean titre of $10^{2.3}$ skin ID_{50} per ml.

A larger trial was carried out using the same strain of sheep pox virus at the 14th tissue culture passage. Ten cattle in Group I received $10^{3.0}$ TCD_{50} (or $10^{2.7}$ sheepskin ID_{50}) intradermally, while 7 cattle in Group II received $10^{3.6}$ TCD_{50} (or $10^{3.3}$ sheepskin ID_{50}) subcutaneously. Two cattle remained as uninoculated controls housed with the inoculated animals. Four animals in Group I showed typical necrotic skin areas post vaccination. Three animals in Group II developed some subcutaneous inflammation at the site of inoculation. One animal in Group II and 1 contact control died from other causes before challenge.

On intradermal titration challenge with virulent cattle passaged "Neethling" virus, all animals in Groups I and II were immune. Of 4 animals used to titrate the challenge material, 1 failed to react and the 3 others showed a mean titre of $10^{4.4}$ skin ID_{50} per ml. The remaining contact control reacted to the challenge material at a titre of $10^{4.7}$ ID_{50} per ml.

These small-scale experiments show that sheep pox virus will protect cattle against intradermal challenge by "Neethling" virus. Further large scale experiments are being carried out on the use of strains of sheep pox virus for immunisation against lumpy skin disease in the field in Kenya.

Yours faithfully,
P. B. CAPSTICK,
J. PRYDIE,
W. COACKLEY,
M. L. BURDIN.

Veterinary Research Laboratory,
Kabete,
Kenya.
May 1st, 1959.

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GENERAL

Hypomagnesaemic Tetany in Calves

Sir, I read with interest the article "Experiment on the Cause of Hypomagnesaemic Tetany in Calves" by J. R. Todd and J. E. F. Rankin, which was published in THE VETERINARY RECORD of March 28th, 1959, and I should like to bring to the authors' notice 2 interesting cases which I have attended.

The first was a case of apparent tetany in a pedigree Ayrshire cow which was seen in December, 1957. The herd had been housed for several weeks. They were being fed the usual concentrates, plus a high magnesium supplement daily.

The cow had been calved about 3 months and was a first milker.

The dairyman had been grooming the cow when, without any previous signs, she suddenly dropped at his feet in a typical tetanic fit. I arrived half an hour later, and, having taken a blood sample, treated her with an intravenous injection of a proprietary Ca.Mg.P. solution (M. & B. M.F.C.) 400 c.c., and a subcutaneous injection of 1 oz. $MgSo_4$ in 10 oz. sterile water. Three hours later she was markedly improved and after rejecting the above, she arose and recovered, without complications.

However, much to my surprise, the blood sample proved entirely normal as to Mg and Ca content! There is no doubt, in my mind, that the cow was exhibiting typical signs of hypomagnesaemia and this seemed to be confirmed by the response to treatment. Perhaps the authors would care to comment on this case?

The second case occurred about the same time. The animal was a dry pedigree Border Leicester ewe, which, when seen by me, had been recumbent for several hours. She was quite quiet and exhibited no signs of hypocalcaemia. I took a blood sample and injected 50 c.c. Ca.Mg.P. mixture (M. & B. M.F.C.) intravenously, following which she arose immediately and walked off. This immediate response agreed with my diagnosis.

The farmer, a very observant client, had noticed that following the introduction of a mineral mixture, high in magnesium, into the field the day before, the ewe had been greedily and persistently consuming it.

The blood sample showed a normal Ca level but markedly increased Mg level! I presume that this was due to an excessive intake of Mg during the previous 24 hours and that the upset in the ratio Ca/Mg had produced the signs of hypocalcaemia, which were corrected by the injection of calcium.

In view of this interaction between Ca and Mg I find it hard to understand the rationale behind the authors' treatment of calf No. 10, which was affected with hypomagnesaemia, and have spoken to some very experienced veterinary surgeons who would use calcium in preference to magnesium in the treatment of hypomagnesaemic tetany, and have done so with good results.

What is the authors' view on this matter and how would they explain the recoveries?

Yours faithfully,
H. C. WILSON.

134, Bonnygate,
Cupar,
Fife,
Scotland.
May 6th, 1959.

Nematodirus spp. Infection and Resistance in Lambs

Sir,—In his interesting contribution, Gibson (*Vet. Rec.* 1959. **71.** 362) refers to low Nematodirus worm burdens associated with high Nematodirus egg counts found in 2 lambs which died after severe scour, while a third lamb, which survived the infection, had a lower egg output and a high worm burden when slaughtered and examined. Mr. Gibson considers it likely that there was a difference in the inherent resistance of the lambs, a view which is in support of the opinion previously expressed regarding lambs in other flocks exposed to Nematodirus infection (Baxter, 1957a). While differences in inherent resistance of the lambs may be important in varying the pathogenicity, development, and reproduction of the acquired Nematodirus infection, another factor to be considered is that infected lambs may void large numbers of both adult and immature Nematodirus worms in their faeces thus reducing the number present in the small intestine.

Whether the partial evacuation of the burden is solely due to a change of environment for the parasite because of early inflammatory changes in the mucosa of the small intestine or whether the self-cure mechanism is operating is not clear. Both factors together, as well as others at present unrecognised, may operate in the case of lambs which continue to be exposed to infection. Under field-scale experimental conditions survivors of clinical nematodiriasis in springtime have lower Nematodirus worm burdens when slaughtered in the late summer and autumn than their infected but not clinically affected flock mates (Baxter, 1957b). This appears to be evidence of the operation of an acquired resistance to the presence of the parasite which is more strongly developed in the lambs which have been most severely affected clinically.

The acquired resistance is, as is usually the case, not an absolute one, as was observed in an experiment which has been fully reported elsewhere (Baxter, 1958). Lambs were exposed to Nematodirus infection at the time of peak larval emergence in March and April, 1957, when most of them became infected and some were clinically affected. In August, 1957, when the lambs were about 6 months old, 5 of them were exposed to a second, naturally-occurring, autumn larval peak. Of the 5 lambs, 3 had been clinical cases in the spring and the fourth had been infected but not clinically affected. The fifth lamb had not passed Nematodirus eggs at any time, and on this basis was regarded as being free of infection while at the time of re-exposure the others had not passed eggs for at least 6 weeks. The result of exposure to the autumn infection was that 4 of the lambs became infected and voided Nematodirus eggs although they were not clinically affected. The lamb which failed to become re-infected or in which the second infection, if any, was non-patent, was one of the clinical cases in the spring.

In the preceding paragraph reference is made to the occurrence of an autumn peak of Nematodirus larval emergence. Both *N. filicollis* and *N. battus* took part in the autumn peak as they also did in the spring peak. Both infections occur in this area. That the main method by which the infection persists on a farm from one year until the next is by infection on the pasture itself is well-known and has been commented on by Taylor (1934) and more recently by Kingsbury (1953), Stamp *et al.* (1955), Thomas & Stevens (1956), Baxter (1957a), and Spedding *et al.* (1958). Gibson (1958) has indicated that *N. filicollis* eggs may hatch to some extent throughout the summer of the year in which they are voided on to pasture, but it has been considered that *N. battus* eggs do not hatch until the following spring. An outdoor pot experiment conducted at this laboratory at the same time as the pasture observations were made in 1957 provided evidence that *N. battus* eggs could hatch some 15 to 17 weeks after they were deposited, in freshly voided sheep's faeces of liquid consistency, on the grass in the pots. The time at which these eggs hatched coincided with the period during which the autumn larval peak occurred on the naturally infected areas (Baxter, 1958).

The extraordinary persistence of Nematodirus infection is well illustrated by Gibson's confirmation of the fact that if a contaminated paddock is left vacant for almost 2 years a sufficiency of infective material remains to bring about a patent but non-clinical infection in grazing lambs. The Moredun workers first drew attention to this in 1956 or 1957 (Silverman, personal communication). It was confirmed for Northern Ireland last year (1958) when 3 of 12 lambs became infected and voided small numbers of Nematodirus eggs when put to graze in a field which had been contaminated in the spring and summer of 1956 and left ungrazed for the whole of 1957. When 2 of the lambs were slaughtered in the autumn 1 was found to have 3,000 *N. battus* and 1,800 *N. filicollis* worms, and the other to have 200 *N. battus* and 200 *N. filicollis* worms.

Yours faithfully,
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